WDNR Southeast Region
2006 to Present Level 2 Stream Monitoring Results

This data report summarizes the results of data collected by volunteers participating in the Level 2 Citizen Based Stream Monitoring Program. We have analyzed data for temperature, transparency, dissolved oxygen (DO), and pH and included generalized information to help you understand your data.

Since 2006, different levels of stream monitoring have been developed to supplement the Water Action Volunteers Program (Level 1). The Wisconsin Department of Natural Resources (WDNR), River Alliance of Wisconsin, and UW-Extension have conducted a pilot project (Level 2), which has citizens collect stream data using WDNR methods and equipment, and enter data in the WDNR's database.

Volunteers in the Southeast Region of Wisconsin have spent at least one field season monitoring 64 sites since 2006 (**Table 1**). Most volunteers are affiliated with a local watershed group. Groups that participate in Level 2 monitoring and collect data include: Carthage College, Cedarburg Science, LLC, Friends of Milwaukee's Rivers, Friends of Miwaukee's Rivers, Milwaukee River Keeper, Pewaukee Area Monitors, River Edge Nature Center, Rock River Coalition - Waukesha County, UW Parkside Geosciences Club, Wisconsin DNR.

Table 1: Monitoring station names as listed in the WDNR database (SWIMS)

Station ID	Name
683424	Bark River - @ Genessee Lake Road
683240	Bark River - @ Hillside Rd 1m (Bi)
683097	Bark River - Sth 18 Wayside Dousman
603475	Batavia Creek - Cth Ss
10028907	Cedar Creek At Covered Bridge Road
10028908	Cedar Creek At Division Road
10011876	Coco Creek At Yench Road (75m Upstream)
10007750	Dineen Park Pond - Dineen Park Pond
413737	Lincoln Creek - At 54th And Lincoln Dr.
10021069	Lincoln Creek At Mouth
10012489	Little Oconomowoc River At Petersen Rd.
10016560	Main B. Milw. R. - S. Of West Bend Airport On Hwy I.
603301	Melius Creek - At Sth 28 (Bi Sur)

Station ID	Name
683431	Menomonee River - At Menomonee Falls, WI
10011232	Menomonee River - Menomonee River @ North Ave (110m Upstream)
10012584	Menomonee River @ Jacobus Park
10014605	Menomonee River Below Lepper Dam
10028875	Milwaukee River - 4822 W Parkview, Mequon
673105	Milwaukee River - At Cth M (Bi)
413841	Milwaukee River - At Hubbard Park
10012615	Milwaukee River - Lincoln Park North Of Fishing Pier
10012616	Milwaukee River - South Of Estabrook Park Dam
10012518	Milwaukee River @ Riveredge Nature Center @ Streamside Rearing Facility Pump
10021067	Milwaukee River At Bayshore Outfall
10028877	Milwaukee River At Cedar Sauk Rd
10020970	Milwaukee River At Glendale, South Of Montclaire Ave.
10021070	Milwaukee River At Rock Place
10012617	Milwaukee River Between North And Locust
10012484	Milwaukee River Downstream Side Of 1st Bridge Downstream Of Indiana Ave.
10012505	Milwaukee River, Grafton - At Interurban Trail Bridge
10012504	Milwaukee River, Grafton - South End Of Grafton Mill Complex
10012501	Milwaukee River, Grafton - South End Of Lime Kiln Park
673107	Milwaukee River, West Branch - At Sth 45 (Bi)
10014722	Milwaukee River-Waubeka (River Rd.)
10014721	Milwaukee River-Waubeka (Vfw Park)
10029058	MINK CREEK AT CTH S
10014720	Mole Creek At W Center Rd.
10012522	Mud Creek South Of Cedar Sauk Rd.
10012523	North Branch Milwaukee River At Hwy M
463206	Pigeon Creek - At Highland Road, Near Thiensville, WI
10012498	Pigeon Creek Downstream From Friestadt Rd.
10012500	Pigeon Creek Upstream From Rr/Interurban Trail
10012499	Pigeon Creek Upstream From Seminary Dam
10022036	Pigeon Creek Upstream of Seminary Drive Bridge
10014503	Pike River - North Branch
10014502	Pike River At Usgs Station, Uw Parkside
10028969	Pike River Downstream Of Campus Dr
303043	Pike River, South Branch - At Sth 31 (Bi Sur)
10012525	Riveredge Creek @ South Boundary Of Rnc
10012524	Riveredge Nature Center Creek @ Hawthorne Dr.
10028878	Rocky Creek
10020682	Root River @ Environmental Education Community Center
10028879	Seinna Center Creek At Lake Michigan
10012516	South Fork Sussex Creek @ Hwy 164
10021388	Stormwater Ditch At Menomonee River Prkwy - Tributary To Menomonee River
10012490	Sussex (Spring) Creek @ Sussex Wwtf
10028970	Trib To Pike River Near 16th
10012483	Trinity Creek @ Baehr Rd.
10028775	Ulao Creek - Hwy 60 East Of Hwy 43
10028774	Ulao Creek - At Falls Rd East Of Hwy 43
10028773	Ulao Creek - Bonniwell At Oriole Lane
10012614	Ulao Creek @ Pioneer Rd., Mequon
10008817	Un Cr (Mole Creek) Station #1, Up From Maple Road
10012582	Unnamed - Trinity Cr West Of Bike Path/Rr Tracks

Understanding the Level 2 Stream Monitoring Data Report

This report provides summary information for data collected by volunteers participating in Level 2 monitoring. Volunteers typically monitor each site once per month from May to September. Some volunteers monitor sites more frequently or over a longer period of time. The report includes all data for Southeast Region that were entered into the WDNR database (SWIMS) under the CBSM Program.

This report highlights monthly recorded values for dissolved oxygen (DO), pH, transparency, and temperature. Data are summarized to report minimum, maximum, and median values for the period the site has been monitored. We also report minimum, maximum, and mean daily temperatures calculated from temperature data originally recorded hourly by continuous data loggers.

Obtaining Raw Data From the WDNR Database (SWIMS)

For more information about a specific site, water monitoring volunteers can log in to the WDNR's database and download data entered into SWIMS. Visit: http://prodoasjava.dnr.wi.gov/swims to login to the database, and follow these steps to download the data about a specific site:

1. Choose the link for the Citizen-based Stream Monitoring Pilot Project near the center of your screen.

2. On the left side of the screen that appears, pick your WDNR Region (i.e., Northeast (NER), Northern (NOR), South Central (SCR), Southeast (SER), or West Central (WCR).

3. Pick your monitoring project from the list on the left.

4. At this point a list of reports which contain the raw data for each site that was monitored will appear in the center of the screen. Choose which report you want to view. You will have the option to view the report online (html option), as a csv file (this will open as an Excel file), or as a pdf file.

Helpful Terms

In this report, for each parameter monitored, some statistical information is provided to help explain what has been found. You may want to refer back to this section as you read through the report to help you understand what is being presented.

Mean: This is the average score in a dataset, or a typical expected value.

Median: This is the middle value in a data set of ranked values. When few data points have been collected, the median is considered a better estimate than the mean for a typical expected value.

For instance, assume the following readings (in mg/L) were found for five D.O. assessments: 10.5, 10.0, 12.5, 14.5, and 8.0. Ranking them in order from lowest to highest, we get: 8.0, 10.0, 10.5, 12.5, and 14.5. The value in the middle of that ranked data set is 10.5.

Thus, 10.5 mg/L is the median. (If you have an even number of data points in the data set, the median is the mean of the middle two numbers in the ranked list.)

If we determined the mean for the same data set, very high and/or low values might affect it. For this example the mean is determined in the following way:
8.0 + 10.0 + 10.5 + 12.5 + 14.5 = 55.5

55.5/ 5 = 11.1 mg/L   Thus, 11.1 mg/L is the mean.

Although there isn't a large difference in the median (10.5 mg/L) and the mean (11.1 mg/L) in this example, in a small data set where one or two values are very different than most of the other values, using the median instead of the mean should provide a better estimate of the expected value. In a large data set, the mean and median are expected to be the same or nearly the same.

Dissolved Oxygen

Dissolved oxygen (DO) is a gas found in water that is critical for sustaining aquatic life (just as oxygen is required for us to survive). Dissolved oxygen enters water through mixing with air in turbulent waters or through photosynthetic processes by aquatic plants and algae. Dissolved oxygen leaves water through decomposition of organic materials that have entered the system from point or non-point source inputs (such as runoff from a yard or field), plant respiration and oxygen demand by organisms such as macroinvertebrates and fish. DO varies over a 24-hour period, with lowest levels expected just before sunrise, when plants and animals have been respiring, but photosynthesis has not been occurring. This flux over a 24-hour period is called diurnal variation. Large fluctuations in diurnal DO levels (e.g., 8-10 mg/L and supersaturated conditions at times) generally indicate increased photosynthesis and respiration due to elevated levels of plant and/or algal growth. Streams having levels of dissolved oxygen at greater than 100% saturation (i.e. supersaturation) do so during the day when the rate of oxygen production via photosynthesis exceeds the rate of diffusion of dissolved oxygen from water to air. Levels of DO saturation typically range from 80-120%, although highly productive streams can experience levels upwards of 140-150% during the middle of the day.

Dissolved oxygen levels are important in determining various communities of aquatic life. DO levels below 2 mg/L generally do not support aquatic life, and most fish and many insects cannot tolerate levels below 4-5 mg/L for a sustained period of time. DO levels above 7 mg/L are amenable to coldwater species such as trout. Different species of fish will migrate within a stream to seek suitable dissolved oxygen conditions.

There are several categories by which waters of Wisconsin are classified by state law. These include (but aren't limited to) trout waters, other fish or aquatic life-designated waters, limited forage fish communities, and limited aquatic life communities. There are defined DO minimums set for each type of classification. The minimums are designed to allow the aquatic organisms defined in the classification to survive in those waters. Since different organisms have different DO requirements, the DO minimums vary based on stream classification. **Table 2** shows the minimum DO allowed in waters classified in certain ways by Wisconsin state law.

Table 2: Minimum dissolved oxygen levels allowed for waters with varied

Stream classification	Minimum dissolved oxygen allowed
Trout waters	6 mg/l (out of spawning season) and 7 mg/L (during spring/fall spawning season)
Fish or aquatic life-designated waters	5 mg/L
Limited forage fish waters	3 mg/L
Limited aquatic life waters	1 mg/L

Is My Site on a Warm Water or Cold Water Stream?

You can identify if your stream is designated as a trout stream by opening this file from the Wisconsin Department of Natural Resources (WDNR) website (available at: http://dnr.wi.gov/fish/species/trout/wisconsintroutstreams.pdf).

Lists of waters that are designated as limited forage fish or limited aquatic life communities are included in Chapter NR 104 Uses and Designated Standards (available at: http://dnr.wi.gov/org/water/wm/wqs/codes/nr104.pdf) and in Chapter NR 102 Water Quality

Standards for Wisconsin Surface Waters (available at: http://www.legis.state.wi.us/rsb/code/nr/nr102.pdf).

You can also create your own maps of your monitoring station and river using the ***Surface Water Data Viewer***. More information is located at: http://dnr.wi.gov/org/water/data_viewer.htm

Dissolved Oxygen and Temperature -- a Special Link

Since DO and temperature are intimately related (e.g., water with a higher temperature can hold less oxygen than water with a lower temperature, so the general concentration of the two parameters in water generally mimic one another), it's important to consider the two together (Table 3).

Dissolved oxygen content in streams is linked with temperature requirements of aquatic life. Colder water generally holds more oxygen and warmer water holds less oxygen.

Table 3: Dissolved oxygen requirements of aquatic plants and animals

Very High DO	Moderately high DO	Low DO
A N I M A L S		
Brook or rainbow trout	Brown trout	Carp
Mottled sculpin	Redbelly dace	Green sunfish
	Bass	Fathead minnow
P L A N T S		
Much plant variety	Moderate plant variety	Little plant variety

Source: Dane County Water Watchers

Transparency

Stream water transparency is a measure of water clarity made with a transparency tube. The transparency tubes used by Level 2 Stream Monitors are 120 centimeters (cm) long and have a black and white disc at the bottom. Transparency is measured by determining the maximum depth of water in the tube that still allows the black and white disc to be visually detected from above. Transparency is measured in centimeters. Since the maximum tube depth is 120 cm, when the disc is visible with a full tube of water, the exact transparency is not measurable, but is greater than or equal to 120 cm. High transparencies indicate good water quality (Figure below).

Figure 1

Low Water Transparency Influences Fish Health

Source: Minnesota Pollution Control Agency
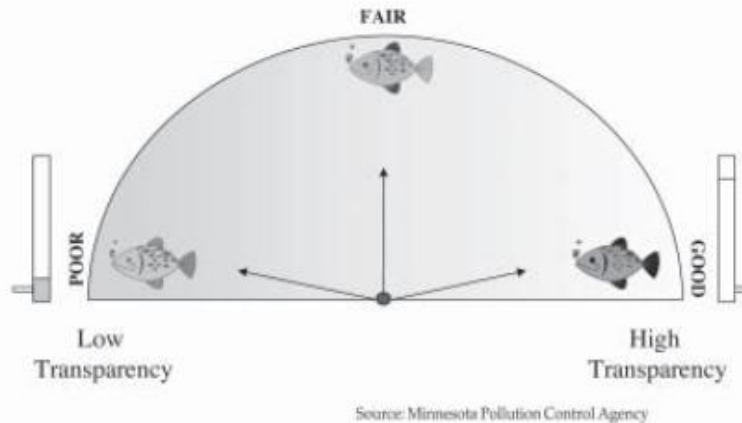
Transparency measurements are affected by both the presence of suspended particles, such as soil particles and microscopic organisms, and by water color, which is caused by certain dissolved substances. Transparency is an easily made measurement that can be correlated with turbidity, although the two measurements are not directly comparable.

Turbidity is a somewhat more difficult measurement that is often made in a lab. Turbidity has been a commonly used measurement in water quality studies and its relationship to the health of fish and other aquatic life has been established.

Turbidity is a measure of water clarity or "cloudiness" caused primarily by the presence of suspended particulate matter. It is basically an optical measurement of the amount of light scattering caused by fine organic or inorganic particles and to a lesser extent some dissolved substances in the water. These small particles of soil, algae or other materials generally range in size from microscopic to about one millimeter (about the thickness of a pencil lead). More suspended particles cause greater turbidity resulting in less light penetration through the water. This hinders photosynthesis, necessary for healthy aquatic plant growth and production of dissolved oxygen. With increased turbidity, water also becomes warmer because the suspended particles absorb heat. Since warmer water holds less dissolved oxygen than cold water, oxygen levels are also affected by turbidity. Extremely high levels of turbidity may also impair aquatic organism survival, for instance, by blocking gas exchange in membranes used for respiration, interfering with filter feeding mussels, or by restricting predation by sight-feeding fish. In general, turbidity increases with increasing river flow due to erosional processes and bad sediment resuspension. Sources of turbidity include:

- erosion from fields, construction sites
- urban runoff from rainstorms and melting snow
- eroding stream banks
- decaying plant matter
- large number of bottom feeders (such as carp) which stir up bottom sediments
- algae
- wastewater discharges

All streams have background or normal levels of water clarity. Fish and aquatic life that inhabit particular streams are adapted to those background levels of water clarity. Time is probably the most influential factor in determining how turbidity affects the aquatic environment. The longer the water remains at unusually high values of turbidity, the greater effect it has on fish and other aquatic life. Fish in particular become very stressed in waters that remain highly turbid for a long time. Signs of stress include increased respiration rate, reduced growth and feeding rates, delayed hatching and, in severe cases, death. Fish eggs are ten times more sensitive to changes in turbidity than adult fish.

Since transparency is a surrogate measurement of turbidity and the two measurements are correlated, Table 4 can be used to covert transparency values to approximate turbidity values. Figure 2 can be used to further understand how the resultant turbidity values and exposure times impact fish.

Table 4: Transparency conversion from cm to NTUs

Transparency (cm)	Turbidity (NTUs)
<6.4	>240
6.4 to 7.0	240
7.1 to 8.2	185
8.3 to 9.5	150
9.6 to 10.8	120
10.9 to 12.0	100
12.1 to 14.0	90
14.1 to 16.5	65
16.6 to 19.1	50
19.2 to 21.6	40
21.7 to 24.1	35
24.2 to 26.7	30
26.8 to 29.2	27
29.3 to 31.8	24
31.9 to 34.3	21
34.4 to 36.8	19
36.9 to 39.4	17
39.5 to 41.9	15
42.0 to 44.5	14
44.6 to 47.0	13
47.1 to 49.5	12
49.6 to 52.1	11
52.2 to 54.6	10
>54.7	<10

Figure 2: Relational trends of freshwater fish activity to turbidity values and time
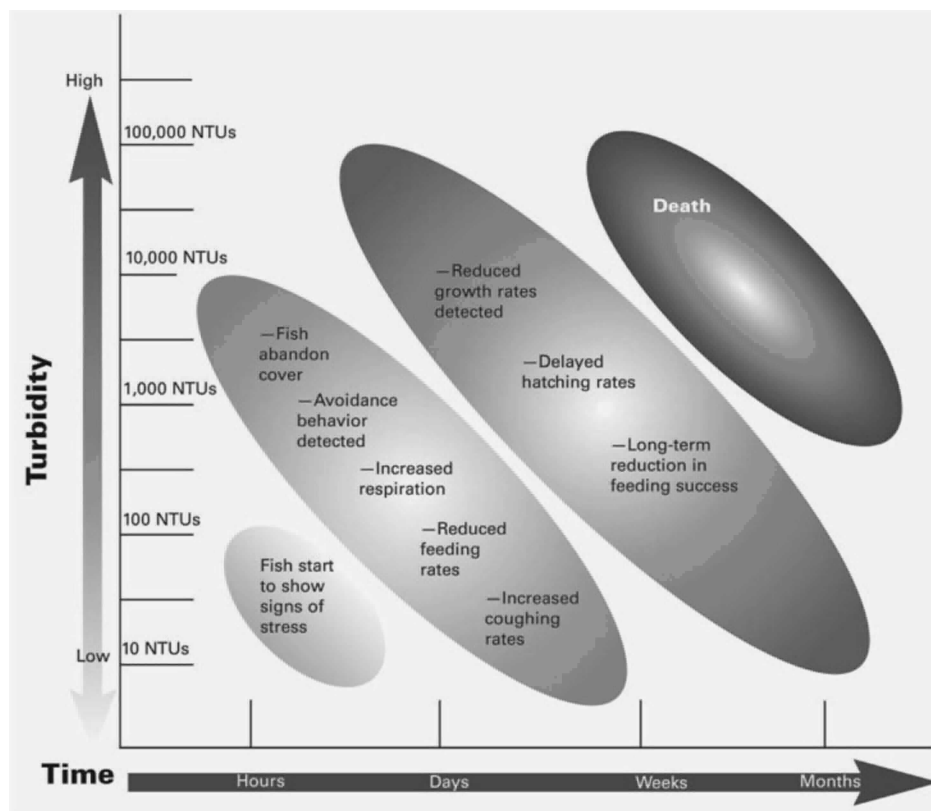
Water Temperature

Water temperature is an important physical property that influences the growth and distribution of aquatic organisms. It is also an important factor regulating chemical and biochemical reactions in aquatic animals and plants. Surface water temperature is strongly influenced by solar radiation, local climate and groundwater inflows.

Wisconsin uses water temperature as an important variable in the designation of fish and aquatic life uses for surface waters. Use designations are utilized to classify waters of the state into certain categories so that management decisions can be made to protect the quality of those water resources.

Long-term water temperature data are useful for interpreting temporal variations. The WDNR uses temperature data averaged over months or seasons to calculate effluent limits. By setting effluent limits to surface waters, aquatic life present in the streams being monitored can be protected.

The WDNR also classifies streams by their water temperatures, indicating if they are cold, cool, or warm water streams (Table 5).

Table 5: Thermal criteria for cold, cool and warm water streams in Wisconsin

Thermal regime	Maximum instantaneous temperature	Maximum daily mean temperature
Cold water stream	<25 °C (77 °F)	< 22 °C (72 °F)
Cool water stream	25-28 °C	22-24 °C
Warm water stream	>28 °C (82 °F)	> 24 °C (75 °F)

These classes of streams support different types of fish species. The best quality coldwater streams have relatively few species of fish as compared to warm water streams. Salmonids such as brook trout dominate the fish populations in the best quality coldwater streams, while brown trout, an exotic salmonid species, dominate coldwater streams that have slightly less pristine water quality. Bass, darter and sucker species are more prevalent in warmwater streams than in coldwater streams. Different species of fish have different temperature requirements. Trout need cool temperatures, while fish species such as bass can live in waters with higher temperatures (see figure 3 on following page).

Figure 3

Most Aquatic Freshwater
Invertebrates Die 40°C ➡   **40°C**
(104°F)

Largemouth & Smallmouth
Bass Die 35°C ➡   **35°C**
(90°F)

30°C
(86°F)

Brown Trout Die 27°C ➡

Rainbow Trout Die 25°C ➡   **25°C**
Brook Trout Die 24°C ➡   (77°F)

Some Mayfly and Stonefly
Larva Die 20°C ➡   **20°C**
(68°F)

15°C
(59°F)

10°C
(50°F)

5°C
(41°F)

0°C
(32°F)

More Plant Growth

21-30°C Optimal temperature
range for bass, sunfish,
catfish, minnows, darters,
northern pike, dragonfly larva

10-20°C Optimal temperature
range for trout, sculpin,
and larva of mayfly,
stonefly, caddisfly

4.5-10°C Optimal temperature
range for brook and
brown trout spawning

Illustration by Jeffrey J. Strobel
UW-Extension Environmental Resources Center

Based on the table above and your site's minimum, maximum and mean water temperatures for each month (see next page), how would you classify your stream based on its temperature over time? Coldwater, coolwater, or warmwater? If you monitor macroinvertebrates, how do your findings for macroinvertebrates and temperature compare with their temperature tolerances as listed in Figure 3? Do you find many plants at your monitoring site? Does their presence make sense in relation to average water temperatures?

The following pages summarize the results of monitoring in the Southeast Region.

Dissolved Oxygen (Instantaneous Data) at Stations in Southeast Region
2006 - Present
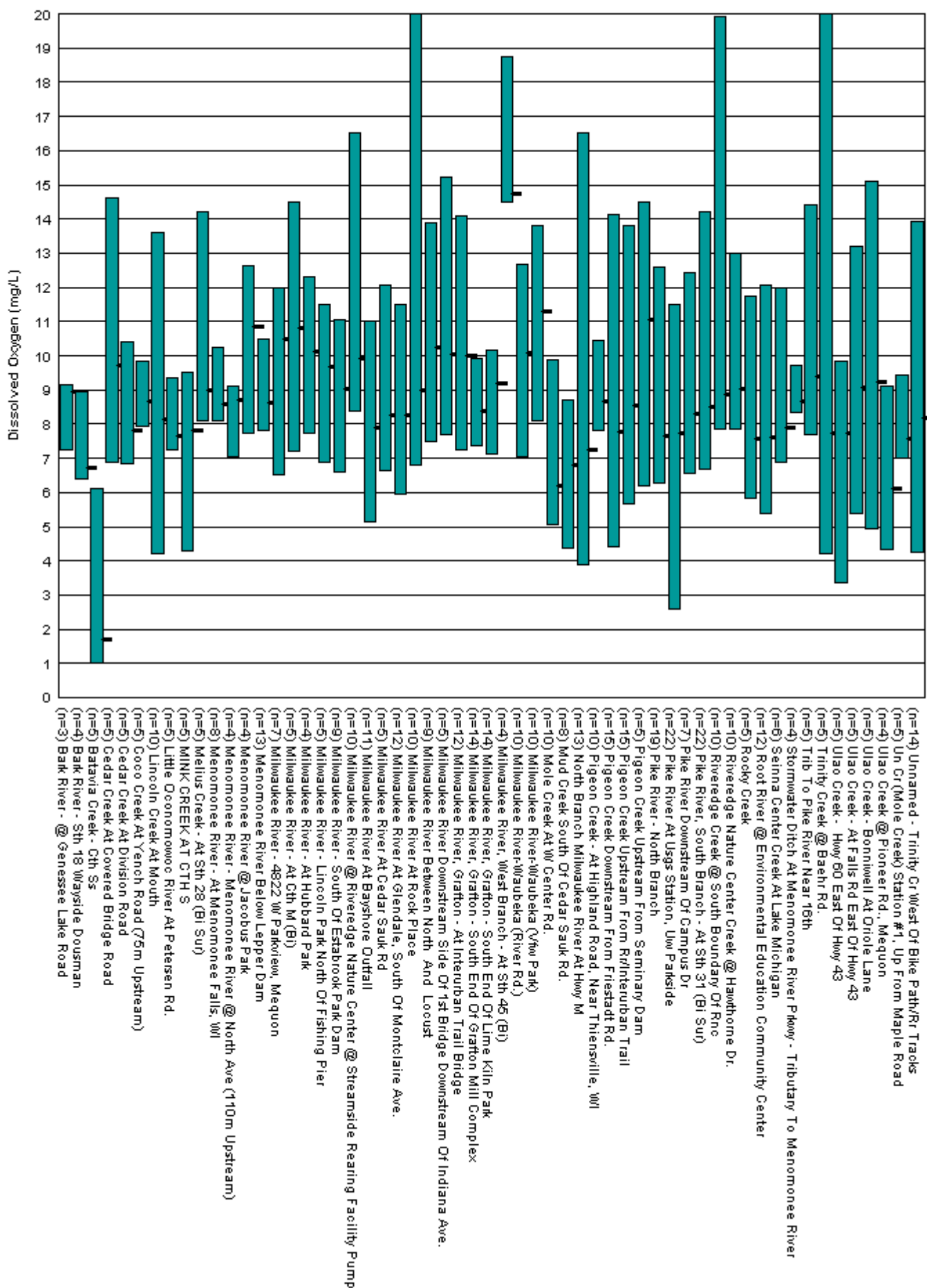
Dissolved Oxygen % Sat. (Instantaneous Data) at Stations in Southeast Region
2006 - Present

pH Values at Stations in Southeast Region
2006 - Present

pH

Y-axis values (top to bottom): 11.00, 10.75, 10.50, 10.25, 10.00, 9.75, 9.50, 9.25, 9.00, 8.75, 8.50, 8.25, 8.00, 7.75, 7.50, 7.25, 7.00, 6.75, 6.50, 6.25, 6.00, 5.75, 5.50, 5.25, 5.00, 4.75, 4.50, 4.25, 4.00

Station labels (left to right):
- (n=3) Bark River - @ Genessee Lake Road
- (n=4) Bark River - Sth 18 Wayside Dousman
- (n=5) Batavia Creek - Cth Ss
- (n=5) Cedar Creek @ Covered Bridge Road
- (n=5) Cedar Creek @ Division Road
- (n=5) Coco Creek @ Yench Road (75m Upstream)
- (n=10) Lincoln Creek @ Petersen Rd.
- (n=5) Little Oconomowoc River @ Petersen Rd.
- (n=5) MINK CREEK AT CTH S
- (n=5) Mellus Creek - @ Sth 28 (Bi Sur)
- (n=8) Menomonee River @ North Ave (110m Upstream)
- (n=2) Menomonee River - Menomonee Falls, WI
- (n=3) Menomonee River @ Jacobus Park
- (n=13) Menomonee River Below Lepper Dam
- (n=7) Milwaukee River - 4822 W Parkview, Mequon
- (n=5) Milwaukee River - @ Cth M (Bi)
- (n=5) Milwaukee River - @ Hubbard Park
- (n=9) Milwaukee River - Lincoln Park North Of Fishing Pier
- (n=10) Milwaukee River - South Of Estabrook Park Dam
- (n=11) Milwaukee River @ Riveredge Nature Center @ Streamside Rearing Facility Pump
- (n=5) Milwaukee River @ Bayshore Outfall
- (n=5) Milwaukee River @ Cedar Sauk Rd
- (n=12) Milwaukee River @ Glendale, South Of Montclaire Ave.
- (n=10) Milwaukee River @ Rock Place
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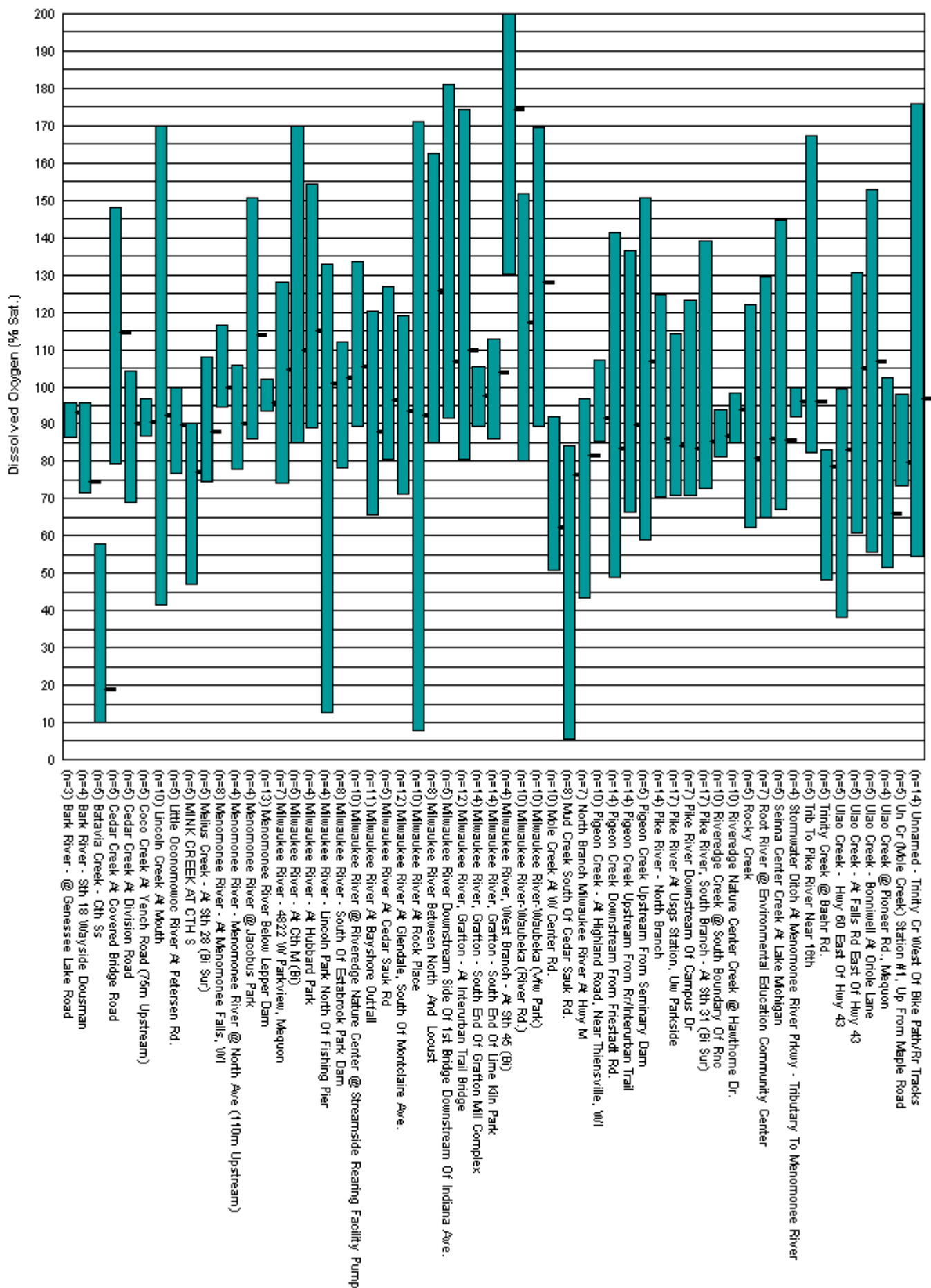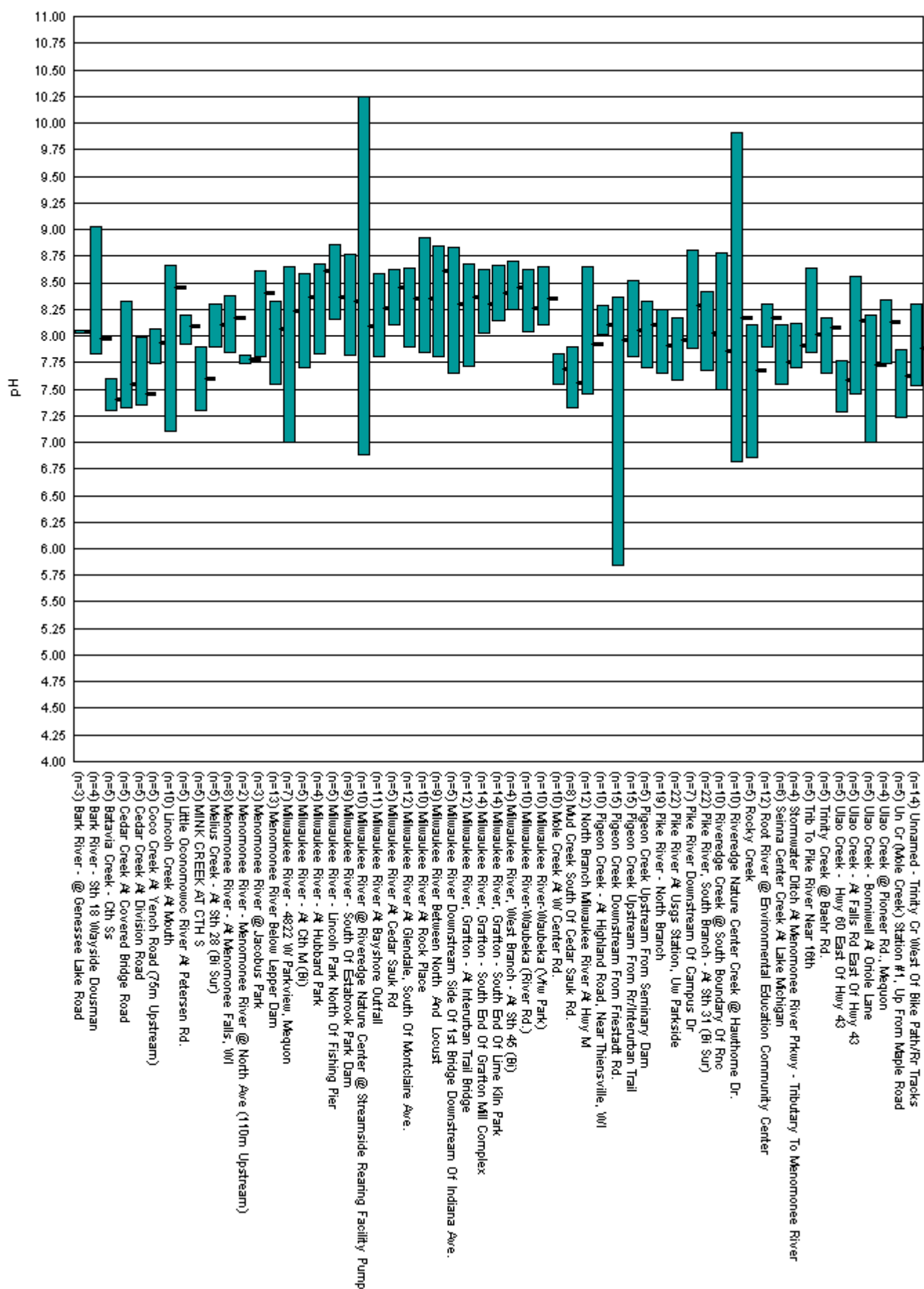- (n=12) Milwaukee River, Gratton - @ Interurban Trail Bridge
- (n=14) Milwaukee River, Gratton - South End Of Gratton Mill Complex
- (n=14) Milwaukee River, Gratton - South End Of Lime Kiln Park
- (n=9) Milwaukee River, West Branch - South Of Estabrook Park Dam
- (n=4) Milwaukee River, West Branch - @ Sth 45 (Bi)
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- (n=19) Pike River - North Branch
- (n=22) Pike River @ Usgs Station, Uw Parkside
- (n=7) Pike River Downstream Of Campus Dr
- (n=22) Pike River, South Branch - @ Sth 31 (Bi Sur)
- (n=10) Riveredge Creek @ South Boundary Of Rnc
- (n=10) Riveredge Nature Center Creek @ Hawthorne Dr.
- (n=5) Rocky Creek
- (n=12) Root River @ Environmental Education Community Center
- (n=4) Senina Center Creek @ Lake Michigan
- (n=4) Stormwater Ditch @ Menomonee River Prkwy - Tributary To Menomonee River
- (n=5) Trib To Pike River Near 16th
- (n=5) Trinity Creek @ Baehr Rd.
- (n=5) Ulao Creek - Hwy 60 East Of Hwy 43
- (n=5) Ulao Creek - @ Falls Rd East Of Hwy 43
- (n=4) Ulao Creek @ Bonniwell @ Oriole Lane
- (n=5) Ulao Creek @ Pioneer Rd., Mequon
- (n=5) Un Cr (Mole Creek) Station #1, Up From Maple Road
- (n=14) Unnamed - Trinity Cr West Of Bike Path/Rr Tracks

pH

Transparency (Instantaneous Data) at Stations in Southeast Region
2006 - Present